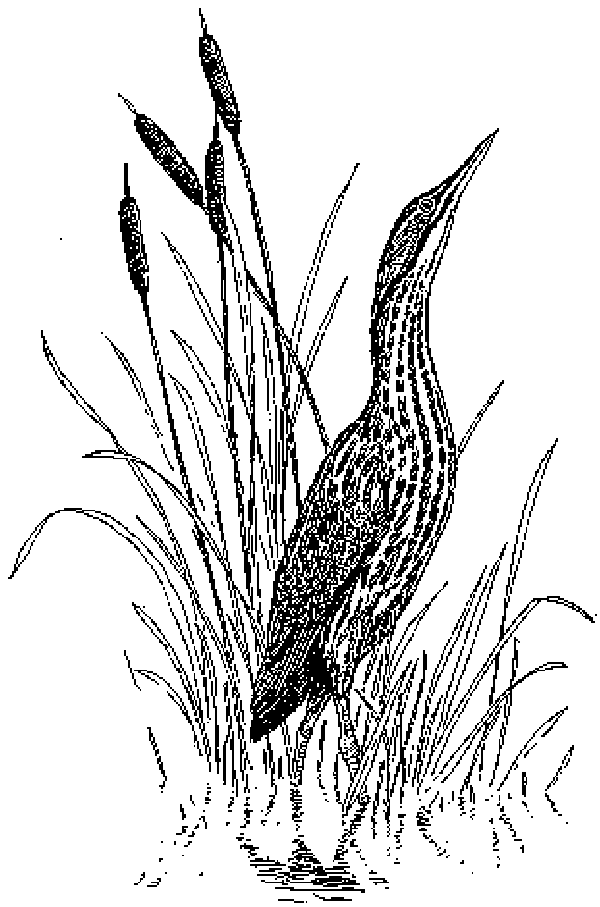
Casco Bay Watershed
Wetlands Characterization



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Casco Bay Watershed Wetlands Characterization

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ABSTRACT

Wetlands are some of the most ecologically valuable places in our landscape, contributing vital functions which enrich surrounding uplands and adjacent waterways. Conservation of wetland functions and values requires an understanding of the ways in which wetlands interact with their local and regional landscapes. Attempting to determine relative importance of wetland functions and values across a watershed is costly and time consuming using established functional assessment methods. The Maine State Planning Office and the Maine Department of Environmental Protection, in cooperation with other state and federal agencies, have worked on a pilot project in the Casco Bay Watershed to develop a watershed-based wetlands characterization method using geographic information systems (GIS). The Casco Bay Watershed encompasses 985 square miles stretching from rural areas in Maine's western mountains to the southern coast and includes Portland, the most developed area of the State. The watershed includes freshwater and marine wetlands and 578 miles of coastline along Casco Bay, an estuary of national significance.

The GIS was built using data available for the entire state so that the method could be transferred to other watersheds. Functional queries were designed for several wetland "indicator" functions which when applied to the GIS, identified wetlands with the potential to provide those functions at a significant level. Results of the watershed-based wetlands characterization in conjunction with ancillary data can be used in many ways: to inform and support wetlands conservation and protection programs at the state, local and national levels; as an aid in municipal and regional planning, including open space, habitat and water quality planning; and to provide information on wetlands and affiliated upland systems for use in compensatory mitigation situations. enhancement, and acquisition.

BACKGROUND

Conservative estimates indicate that wetlands cover 25% or 5 million acres of Maine's area. Historically, wetlands have been seen as unfortunately soggy landscapes of little use. In fact, as recently as 20 years ago, programs at both the federal and state levels focused on ditching and draining wetlands. We now know that wetlands provide important biological, geochemical, and hydrological functions to their immediate environs and to the watersheds in which they are found. These functions include floodflow control, sediment/toxicant retention, shoreline stabilization, nutrient cycling, groundwater recharge/discharge, and wildlife and plant habitat including habitat for many federal and state listed rare and endangered plants and animals. Wetlands also play key roles in maintaining the water quality and quantity of surface and groundwater systems, provide opportunities for both passive and active recreation, commercial fishing and shellfish harvesting, and aesthetic values for the human populations around them.

While Maine now regulates wetlands when impacts within the wetland exceed 4300 square feet, protection of the wetlands' functional capacity requires protection beyond that which is focused on the "footprint" of the wetland (Kusler, et. al. 1995). With the abundance of wetlands across Maine, it is in fact difficult to make changes to the landscape without some impact upon wetlands and their functions and values. With increasing levels of growth and development across the State, protecting functional capacity is becoming more important and more difficult at the same time.

The first steps toward protection of a wetland's functional capacity include identification and inventory followed by characterization of functional capacity. Such characterizations are traditionally accomplished by visiting a site and applying one of the many wetland functional assessment methods currently in use, a time-consuming and expensive undertaking. With the number and variety of wetlands found in Maine, and the size of the state, it is unrealistic to expect that traditional ground-level functional assessments can be broadly performed. Even if it were possible to complete functional assessments of large numbers of wetlands across the State, data would still be lacking to illuminate how those wetlands interact with each other and their affiliated upland systems. In 1996, the Maine Wetlands Conservation Task Force recommended that something in between a field analysis of individual wetlands and the limited information provided by a simple wetland cover map would have substantial benefit in furthering the goal of wetland protection.

The Watershed-based Wetlands Characterization Method profiles wetlands within a watershed and determines relative significance based upon six specific functions and values. This characterization process, in conjunction with ancillary data can be used in the identification of compensatory mitigation opportunities, protection and enhancement of water quality, planning for growth, planning for open space and habitat conservation, and identification of priorities for acquisition, stewardship, restoration, and enhancement of wetlands and affiliated upland systems. Characterizations enhance the state's ability to evaluate the functions that wetlands provide and to characterize landscape and system level functions which are critical for cumulative impacts assessment and for conservation of biodiversity (Theising, 1998).

Based upon the conservative nature of the queries and the base maps used, there is a high level of confidence that wetlands characterized with a functional attribute are indeed performing that function at a significant level. It would therefore be an appropriate use of the characterization results to consider additional protection of wetland systems and associated uplands when the identified attributes are valued by a local community. However, because not all functions or values are considered in the characterization, and NWI maps are known to underestimate both wetland extent and occurrence it would be inappropriate to assume a lack of functions or values based upon characterization results.

GETTING STARTED

SELECTING A GEOGRAPHIC AREA

In 1996, a subcommittee of the Maine Wetlands Conservation Task Force met to discuss the creation of a GIS-based wetlands characterization method. Debate about which type of geographic division to use centered around the value of creating a characterization approach for watersheds or for the state's biophysical regions as described by Janet McMahon (1990). The group decided to use a watershed approach, but with the biophysical regions incorporated as a layer of information, which would be used to inform or modify decisions throughout the method development process. The watershed selection was then discussed, with the Casco Bay watershed chosen due to the variability in the levels of development, the presence of both coastal and freshwater wetlands, and because a recently completed National Estuary Project had compiled data which could be used to check the results of the pilot project.

DEVELOPING GOALS

In 1997, the Maine Wetlands Conservation Task Force convened a steering committee made up of representatives of state and federal natural resource agencies and interested non-governmental organizations specific to Casco Bay (Appendix A). The mix of representation was intended to result in a characterization method with utility across a broad range of programs. The steering committee refined the scope of work passed down from the Task Force by identifying the goals and constraints within which this work would take place. Due to the state's size and the numbers of wetlands included within it, it was determined that a computer geographic information system (GIS) was essential to making this system useful and dynamic rather than a static study of the landscape. In addition, the steering committee decided to use only those digital data layers which were already available or which were becoming available for the entire state, to insure that this technique would be replicable in watersheds statewide. The following goals were developed by the steering committee to guide its work.

Goals of the Casco Bay Watershed Wetlands Characterization Method

Phase I

❖ Create a rapid flexible methodology to characterize wetland-related functions and values within a watershed;

❖ Develop broad agreement on the relative importance of wetland resources within a watershed and establish priorities for acquisition, restoration, and stewardship of those resources;
❖ Encourage the use of the priorities in planning for protection beyond that provided in law and regulation at the local, state, and federal levels;

Phase II
❖ Run a pilot compensation fund which would accumulate resources from approved permit actions to use in achieving the identified priority actions;
❖ Develop a straightforward cost method on which to base fees for permitted actions which will go into a compensation fund.

During the steering committee's initial discussions, it became evident that as important as it was to identify the goals for this project, it was equally as important to officially note actions that were not intended outcomes or goals of this work. Concern was repeatedly voiced that characterizations might be used to undermine wetland protection. <u>This work is a planning tool to improve the protection of wetland resources beyond that offered through the regulatory channels. This work was never intended nor designed to supplant the regulatory framework at the local, state, or federal levels but to improve the quality of the decisions made within it. Neither was it intended to obviate the need for field work as required in the regulatory process.</u> This discussion led the steering committee to identify the following:

<u>Not</u> *Goals of the Casco Bay Watershed Wetlands Characterization Project*

❖ Create wetlands priorities which would be used to diminish the significance or protection of wetlands not identified as priorities;
❖ Circulate maps which would be used or accepted in lieu of delineation and functional assessments required in the permit process;
❖ Undermine existing wetlands protection.

DESIGNING THE SYSTEM

FUNCTIONS AND VALUES

The steering committee discussed and chose wetlands functions and values to include in the characterization. These became known as "indicator" functions in this study. At least one function was chosen from each one of the four groups of functions identified by the Assessment Work Group, a subgroup of the Maine Wetlands Conservation Task Force (Assessment Work Group Report, ed. Maine State Planning Office, 1997). Once the functions were chosen, current research, functional assessment methods, and the knowledge of the steering committee was used to identify the important characteristics which contributed to the ability of a wetland to provide each function (Adamus et. al., 1991; Golet et. al., 1994). The parsing out of these characteristics then determined the final choice of digital layers necessary for the GIS.

Functions and Values Used in the Characterization

❖ Hydrologic functions:
Floodflow alteration: the process through which peak flows are stored and delayed in their downstream journey. This also includes the gradual release of flood waters from wetlands after a storm event.

❖ Biogeochemical functions:
Sediment retention: the potential of a wetland to trap sediment in runoff from surrounding uplands. This can help prevent water quality problems downstream.

❖ Biological functions:
Plant and animal habitat: the potential for a wetland to provide habitat for those species that typically rely on wetlands during some part of their life cycle and wetlands in proximity to occurrence data indicating locations of rare, threatened, and endangered species and communities.

Finfish habitat: the potential for a wetland to provide habitat for fish species based upon their life cycle needs.
Shellfish habitat: the potential for a wetland to provide or impact shellfish habitat.

❖ Cultural values:
Education and research: the potential for wetlands to provide educational, recreational, or research opportunities.

DATA LAYERS
At the same time that the committee determined which indicator functions to use in the characterization, the steering committee also evaluated existing digital data layers and the extent of statewide coverage. Using the experience of the committee members and aided by a wetland consultant hired for the project, a list of digital data layers for possible inclusion in the project was developed. These layers were viewed as potentially useful in describing physical features that relate to a wetland's opportunity to provide one or more of the project's indicator functions at a significant level. Concerned with the inherent biases and imperfections of each data layer, and to minimize the magnification of errors and biases which can occur when data from different sources are superimposed, the number of layers was kept to a minimum while still creating a system powerful enough to complete the task. There was clear recognition on the part of the steering committee that there is no replacement for data that has been gathered from ground surveys. However, it would be cost and time prohibitive to gather that level of field data for the entire state. Using the characterization as envisioned, to broadly categorize and screen wetlands resources, makes it possible to use the results to target

intensive field work as a next step in the identification of priority wetlands and affiliated uplands.

Digital Data Layers Used in the Characterization
1:24000

- National Wetlands Inventory
- Medium intensity soils survey data (SSURGO)
- Roads
- FIRM flood plain data (FEMA)
- Hydrography: lakes, streams, brooks
- Natural Heritage data
- Shellfish harvest and closure areas
- Boat launches
- Schools

GENERATING THE QUERIES

With the selection of indicator functions and data layers completed, the steering committee refined their discussion of wetland characteristics into a series of queries to be applied to the GIS. This process relied heavily on existing wetlands research, functional assessment methods, and the experience of the steering committee. Each query is a logic statement linking the data together such that the resulting “yes” or “no” response to the query is a statement about the existence of the sought after function or value. Running the queries resulted in “hits” for each wetland complex from zero to all six of the indicator functions and values. The resulting characterization begins to build a picture of the watershed based on the wetlands and the functions that they provide. It is important to note that some functions are easier than others to tease out using a GIS system. Functioning wildlife habitat is especially complicated and difficult to assert using an information system rather than a field-verified approach, however, the process does provide an initial filter and a relatively good general indicator for wildlife habitat.

The combination of the available digital layers and the distillation of chosen wetland functions into linked physical and biological features led to the development of the GIS queries. These queries use the data features to infer that wetlands do or do not have the ability to provide the indicator functions at a significant level.

GIS queries

Floodflow Alteration:

Wetlands containing all of the following:

Contained in a flood zone;

Associated with a surface watercourse or waterbody; and

Slope of less than 3%.

Sediment Retention:

Wetlands containing all of the following:

Slope less than 3%;

Emergent vegetation; and

Close proximity to a river, stream, or lake.

Plant and Animal Habitat:

Wetlands containing:

Open water or emergent vegetation;

3 or more vegetation classes; and

Within or adjacent (100ft) to a river, stream, lake or

NWI polygons of Management Concern within 1/4 mile of habitat supporting

Rare, threatened, and endangered plants and animals

Rare and exemplary natural communities

Significant and essential wildlife habitat.

Finfish Habitat:

Wetlands including NWI polygons of the following types:

R1	L1UB	E1UB
R1UB	L1AB	E1AB
R2SB	L2UB	E2AB
R2AB	L2AB	E2SB
R4EM	L2US	E2EM
R3US	L2EM	E2SS
		E2US

And,

Wetlands including NWI polygons of the following types, where adjacent to a river, stream, or lake:

PUB, PAB, PUS, PEM, PSSA, PSSC, PSSF, PSSG, PSSJ, PFOA, PFOC, PFOb

Shellfish Habitat:

Wetlands within ½ mile of

Identified shellfish habitat or

Identified shellfish closure areas or

Mapped eelgrass beds

Or,

Palustrine wetlands directly connected by a stream of ½ mile or less in length to:

Identified shellfish habitat or

Identified shellfish closure areas or

Mapped eelgrass beds

Cultural/education:

Wetlands within ¼ mile of a boat ramp or school. (These wetlands are seen as likely candidates for use as educational resources, adopt-a wetland programs, and wetlands with a built in constituency.)

THE CHARACTERIZATION

Using both ArcInfo and ArcView, the queries were applied to the GIS and the results added to the appropriate database table. Individual NWI polygons were dissolved to form wetland complexes and the queries were run on the complex. The individual polygon attributes were maintained allowing them to be displayed as required. Fields were added to the table for each of the six indicator functions and each wetland received a zero (0) or a one (1) in each of the fields to denote if the wetland did (1) or did not (0) receive a hit for that particular indicator function.

After the queries were applied to the database for the first time and maps were generated, field work was done to check the predictive value of the queries and to ascertain if refinement was needed. Forty wetlands were chosen for site visits. The watershed was divided based on McMahon's biophysical regions (McMahon 1990) and sites were selected based on the relative area found within each of the biophysical regions in the watershed (FIGURE 1). Field visits were made by wetland scientists where a field verification and a modified functional assessment were performed at each site. These visits were made to wetlands with and without hits. The goal of the fieldwork was to determine that wetlands with a hit did in fact have the ability to provide the relevant indicator function at a significant level. Equally as important, the field verifications assessed whether wetlands without hits had been accurately characterized. Information was recorded on a field form developed by the wetlands consultants (Appendix B). The results of the field verification indicated an 89% level of accuracy for cover type mapping, 100% for location, and a 94% level of accuracy for functions found as predicted by the query process.

After reviewing the results of the field work, it was determined that the queries could be slightly modified. The initial habitat query included a screen that selected those wetlands in the top 10% based on size. The steering committee determined that it would be more appropriate to stratify based on size after the queries had been run on the entire population of wetlands. By doing so, large wetlands were not automatically given a higher habitat value than smaller wetlands with a similar profile. In addition, the original cultural query had marked wetlands that had Maine Natural Areas Program or Maine Inland Fisheries and Wildlife occurrence data; since this same statement appeared in the habitat query, it was decided to remove it from the cultural query to eliminate a double hit for the same attribute. This process of reworking the queries and reapplying the characterization shows some of the power and flexibility of using this type of GIS system for data analysis. The characterization was rerun with the modified queries and a "Multihit Layer" was created which displays all the NWI wetlands and the number of hits each received.

THE PRIORITIZATION

RISK INDEX LAYER

Once the characterization was completed, the steering committee explored ways to prioritize the wetlands in a manner that made sense on a watershed level. It was determined that risk of alteration would be an appropriate filter through which to accomplish this. Accepting that the numbers and distribution of wetlands across the landscape make it difficult to alter the landscape without impacting wetlands to some degree, a risk index was built based on impacts to the landscape. Housing completions, Maine Department of Environmental Protection permit-by-rule for wetland-related activities, and Maine Natural Resource Protection Act (NRPA) permits were collected and collated by town. Each of these data layers was divided into five classes by a statistical grouping program within ArcView. Point values from one to five were attached to each class for each of the three measures of threat for each town. The point values from the three layers were summed for each town. This range of values was in turn divided into five classes. Through this method a town could receive as few as three points to a maximum of 15 points. In the Casco Bay watershed, the range was from three to 14. The towns receiving the highest point value generally face the highest levels of risk to wetlands from growth and development; the towns with the lower scores are those currently experiencing less risk.

RESULTS

The Risk Index Layer and the"Multihit Layer" were used to choose sites for full-blown functional assessments. Sites were stratified based on biophysical regions, number of hits, and were allocated across as many risk classes as possible within each biophysical region. As with the field verifications, sites receiving no hits were included in the sample population. Field work was completed at 21 wetlands during the 1999 field season. Reflecting a recommendation made by the Assessment Work Group, both the New Hampshire Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire (Amman and Stone, 1991) and US Army Corps of Engineers New England Division Highway Method (USACE, 1995) were completed at each site and the results compared. The two yielded very similar results.

The New Hampshire method, designed to compare wetlands, relies on the best professional judgment of the individual conducting the assessment to ascribe a numeric point value called a functional value index (FVI) for specific wetland characteristics for a variety of functions and values. This eventually leads to a final "wetland value unit" (WVU) which is the product of the score received and the acreage of the wetland. The Army Corps Highway Method is a more qualitative analysis which relies solely on noting the "presence" or "absence" of wetland characteristics relative to the specific functions and values evaluated. The final wetland value unit of the New Hampshire method does include a weighting based on the size; in order to compare with the Army Corps method, we used unweighted results. The following table describes the results of the two methods. While the New Hampshire Method does yield more detailed information on the functional capacity of a wetland, the Army Corps Method yields a very similar, albeit qualitative, portrait of that same wetland.

Comparison of Functional Assessment Methods

Function/Value	Number of Wetlands Evaluated	Range of Function Value Index (FVI) New Hampshire Method	Mean Average of FVI	Standard Deviation of the Mean FVI	% of Primary Functions of Wetlands Evaluated (Highway Method)
Floodflow Control	19	1.00	1	0	100%
Sediment Retention	19	0.6-0.8	0.7	0.09	100%
Wildlife Habitat	21	0.4-0.9	0.8	0.1	95%
Fish Habitat R/S (Rivers/Streams)	21	0.6-0.9	0.8	0.08	95%
Fish Habitat P/L (Pond/Lakes)	8	0.4-0.8	0.7	0.1	N/A
Education	15	0.6-0.9	0.7	0.1	60%
Historic Site	4	1	1	0	2%
Noteworthiness	21	1.0-3.0	1.5	0.6	100%

As with the field verifications, the functional assessments were used to evaluate the sensitivity of the characterization and to determine that the results of the GIS characterization was supported by what was found in the field.

SUMMARY OF FUNCTIONAL ASSESSMENTS OF TARGET WETLANDS

- Mapped location verified 100% accuracy
- Cowardin (NWI) classification 74% accuracy
- Indicator functions 90% accuracy

The results of the functional assessments indicated that the sampled wetlands were, as predicted, highly functioning wetlands. The two assessment methods and the field verifications confirmed that the indicator functions predicted by the characterization were very likely provided by the site. While the sample size was small compared to the total number of wetland complexes in the watershed, the results support a high level of confidence in the ability of this method to be used in a predictive capacity.

Additional "blind" functional on randomly selected wetlands assessments were performed during the 2000 field season. The wetland consultants were given maps that showed only the locations and NWI classifications of each wetland. The same two functional assessment methods were performed as at the previous sites. The results of the field work were compared with the characterization to determine if the profile of the wetland as predicted by the characterization matched what was found in the field. The final comparison results indicate that the characterization predictions and the results of the functional assessments strongly correspond.

The New Hampshire method identifies a total of 19 functions and values spread across the five wetlands visited. Both the ACE Highway Method and the Watershed Characterization describe thirteen functions across the five wetlands. The largest discrepancy between the Characterization and the NH Method arose on the two wetlands surrounded by development. On a small wetland located in South Portland, the NH Method identified three functions and values; the ACE Highway Method and the Characterization identified only one of these. However, the two remaining functions received functional value indices (FVI) of .2 and .5 out of a possible 1.0 from the NH Method. Based on the stated uses of the NH Method, a planning tool to compare wetlands within a town or watershed, one can infer that these scores would most likely not be ascribed to wetlands performing these two functions at a significant level. At the other wetland surrounded by development, four functions and values were described at the site by the NH Method and the ACE Highway Method while the Characterization predicted only two of those functions. Again, it is important to note that while the ACE Highway method rated four functions at this site, they were all described as "present, not principal" and the FVI's of the NH Method were .4 and .6. The Characterization was designed to identify functions performed at a significant level. When the FVI's and ACE Highway presence/absence indicators are compared with that in mind, there is a high degree of correlation between the functional assessment methods and the Characterization.

Additional Analyses

The Casco Bay Watershed Wetlands Characterization used the vegetation and land cover map developed by the University of Maine and the USGS Biological Resources Division (Hepinstall et al. 1999). The suggested scale limit for greatest applicability of this coverage is 1:40,000. However, this was the most recent and complete land cover map for the state and as such was seen as the best option for this project and its replicability statewide. To minimize stretching the reliability of the data even further, the steering committee chose to use only the major land use classes from this classification. Those classes are:

- ❖ Agricultural lands
- ❖ Forest lands
- ❖ Water and wetlands
- ❖ Developed lands
- ❖ Other

The final Multihit Layer and the land use information were superimposed and the land use classes and coverage were calculated for a ¼ mile buffer around the wetlands used in the characterization. An edge to area ratio for the classes within the buffer was also calculated. This information can be used to get a general idea of the land cover classes surrounding the wetlands and how fragmented those cover classes are (the higher the edge to area ratio, the greater the interspersion of classes). This information helps to fill in the blanks around and between the wetlands. With information such as this, the wetlands characterization becomes more robust. For example, high hit wetlands surrounded by a high percentage of forested cover and a low edge to area ratio might indicate a stewardship opportunity to protect the functional capacity of that relatively intact wetland. A high hit wetland surrounded by developed and agricultural classes might well present an opportunity for compensation or restoration.

Opportunities envisioned at this time to refine and direct the uses of the characterization include,

- ❖ overlaying with the priority watersheds data developed for the Nonpoint Source (319) Program;
- ❖ incorporation into data being developed for towns to use as part of an open space planning process;
- ❖ outreach to land trusts and watershed groups within the study area;
- ❖ outreach to towns and regional planning councils;
- ❖ use of the watershed-based wetlands profile to guide compensation decisions.

Cautions

It is important to remember that the characterization was designed as a planning tool to help focus wetlands planning and conservation actions within a watershed. Recognition of the shortcomings inherent in the data and in the process is imperative when applying the results of the characterization. This does not alter the validity of the results but should inform the application of those results to management of wetland resources.
The base information for wetlands used in this work is the National Wetlands Inventory. This is the only consistent wetlands inventory across the state. The NWI maps are made from photo interpretation of high level aerial photography. As such, they represent a reflection of what is found on the

ground based on the limitation of the photography and the abilities of the photo interpreter. In Maine, it is clear from studies that these maps have a high degree of accuracy in locating wetlands (Nichols, 1994). It is also clear that on the ground the wetlands will probably be larger and more complex than what has been reflected on the maps; NWI maps are widely accepted as a conservative representation of wetland extent. Perhaps the weakest area of the NWI maps is in their representation of the smaller isolated forested wetlands, especially needle-leaved (evergreen) dominated forested wetlands. Additionally, the focus on riparian connectivity in the queries does limit the identification of isolated forested wetlands in the Characterization. This group of wetlands offers some of the most challenging characteristics for this type of approach. Frequently smaller than one acre, they fall below the sensor's ability to discriminate them from the surrounding landscape, and this limitation is compounded by the lack of a readily discernible spectral signature with infrared aerial photography. **In using the characterization, it is important to recognize that the mapped representations of all wetlands are conservative, especially the representations of isolated and drier-end forested wetlands.**

The Characterization uses a subset of the many functions currently ascribed to wetlands. The functions were chosen to represent a cross-section of the major categories of wetlands functions. It is important to remember that there are many other important wetlands functions and values that are not currently included in the characterization.

While most of the functions used in the characterization are fairly straightforward, the habitat functions bear some additional discussion. The goal of the characterization with regard to wildlife habitat was to identify those wetlands that provide habitat for the general suite of wetland affiliated species. The characterization was not developed for use in the identification of species-specific habitat, although observational and mapped data for species and communities of special management concern were included where available. However, where it is possible to transpose the habitat requirements for specific species into queries of the data, more specific habitats could be identified through this process. There are other programs at both the state and federal levels that are working on identification of habitats for species in decline, threatened and endangered species, and species and communities of management concern.
Appendix C lists these agencies and their contact information. Also, as stated above, NWI mapping is limited, thus important habitats such as vernal pools probably will not be picked up.

Significance of this Approach

Healthy wetland systems offer incalculable benefits. Maintaining and improving water quality through sediment retention, nutrient cycling, ground and surface water discharge and recharge; and providing habitat for a whole suite of plant and animal species including rare, threatened and endangered species and communities are just a few. The integrity and quality of our watersheds are inextricably tied to the wetlands within them and vice-versa. The health and welfare of wetlands are dependent upon the health of the watersheds surrounding them. Surface runoff from impervious surfaces, agricultural fields, farms, and forestry operations can overload and degrade wetlands and the functions that they provide. Filling, ditching and draining affect the capacity of wetlands to store water during storm events thus diminishing their ability to ameliorate floodflow and protect water quality. Upland development and the resulting fragmentation of open space affect the quality of wetland habitat and its utility for many wetland-affiliated species, both plant and animal. Clearly, if protection of the functions wetlands provide is important, protection beyond the current regulatory framework is essential.

Using wetlands characterizations, planning for the protection and restoration of wetland functions on a watershed level can become more meaningful. While this project focused on a watershed-wide look at wetland resources, perhaps the most exciting use exists at the local level. The goal of this study was to create a low-cost characterization of wetland resources with a high level of confidence in predicted attributes. This characterization was intended to aid in the protection of wetlands across the spectrum of wetland management options by identifying potential priorities. The condition of affiliated uplands must be evaluated as well in order to accomplish the task.
Land use /land cover data developed from satellite imagery was used at the watershed level. At the town level, zoning maps, build out analyses, and local knowledge could be used to further refine the land use coverage. Site specific knowledge of wetland systems from land trusts, conservation commissions, local residents, and municipal officials are other valuable sources of information. If local information is available in a digital format or can be transferred into a digital format, it can be added to the characterization as an additional layer in the GIS; if not, the information should be used in another manner in this process. Using the characterization in conjunction with ancillary data layers such as land cover, protected lands, threats to groundwater, and zoning reveals a more textured representation of the landscape than that gained by looking at a single factor alone. Decisions made within this more detailed tapestry begin to address the connections and relationships between systems, both natural and man-made. These decisions can then be translated into concrete actions which stand a better chance of accomplishing their designed objectives.

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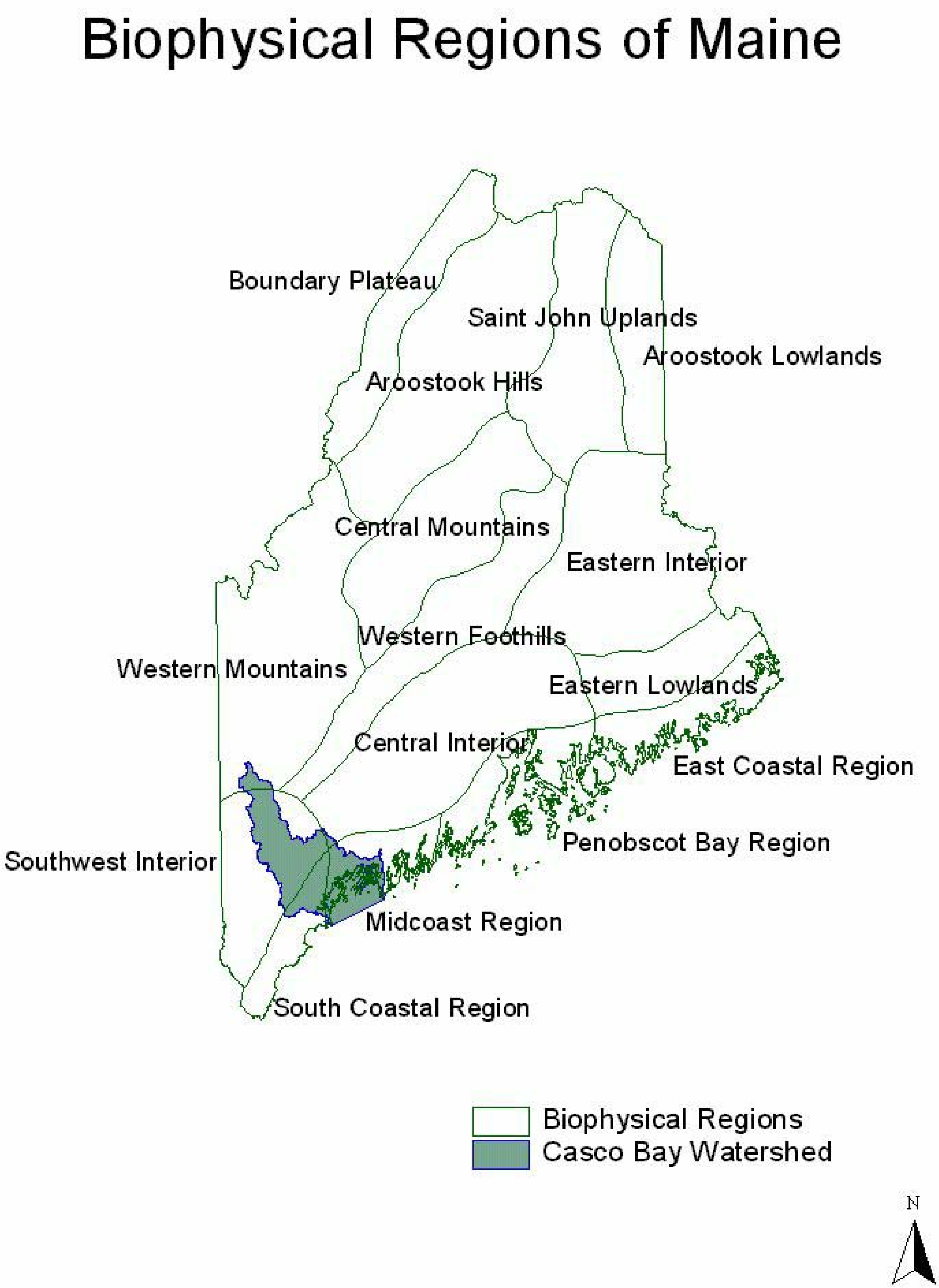
Fi gur e 1


Biophysical Regions of Maine
Boundary Plateau
Saint John Uplands
Aroostook Lowlands
Aroostook Hills
Central Mountains
Eastern Interior
Western Foothills
Western Mountains
Eastern Lowlands
Central Interior
East Coastal Region
Penobscot Bay Region
Southwest Interior
Midcoast Region
South Coastal Region
Biophysical Regions
Casco Bay Watershed
N

Appendix A
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Appendix B

Field Verification Form

Date:

Wetland I.D

Development Level:

Town

County

Field Location Coincides With Mapping: yes no

(*Note: These are the target functions and values assessed by the characterization project using GIS data)*

Function/Value	New Hampshire WVU	Highway Methodology Primary Function
Floodflow Control		
Sediment Retention		
Wildlife Habitat		
Fish Habitat R/S		
Fish Habitat P/L		
Education		
Historic Site		
Noteworthiness		

Wetland Cover type: Does it coincide with mapping?

	Yes	No
PEM		
PSS		
PFO		
PUB		
Stream		

Compensatory Opportunity

	Yes	No	Comments
Restoration□			
Enhancement □			
Preservation□			
Other □			

Land Use within ¼ mile: Does it coincide with mapping?

	Yes	No	Comment
Agricultural Lands□			
Forested Lands			
Clearcut □			
Forested□			
Developed Lands			
#32 Sparse Residential □			
#33 Dense Residential □			

#34 Urban / Industrial □			
#35 Highways/ Runways □			

Photograph #:

HCAMP Flag: yes no

FEMA Mapped yes no

Mapped Sand & Gravel Aquifer yes no

USGS Topo. Map:

NWI Map

Notes:

Appendix C

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